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(54) Name of invention: Styrene resin compound

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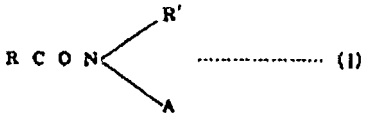
Summary

1. Name of invention

Styrene resin compound

2. Scope of claim

A styrene resin compound comprising including 0.01-5 parts content by weight per 100 parts per weight of compound of general formula (1) in a styrene group resin.



(R is an alkyl group or alkenyl group of 7 to 21 carbons, R' is an alkyl group or alkenyl group of 8-22 carbons, A is an alkyl group or alkenyl group of 8-22 carbons or a hydrogen atom, and one or both of R and R' is an alkenyl group.)

3. Detailed description of invention

(Field of industrial application)

The present invention relates to a styrene group resin compound with improved resin flow characteristics during thermoforming.

(Prior art)

A variety of lubricants have been previously used for the purpose of enhancing the flow characteristics of styrene group resins during thermoforming. Frequently used lubricants include metal soaps such as zinc stearate or calcium stearate, bis-aliphatic amides such as N, N'–bis-stearo-ethylenediamine, aliphatic amides such as stearate amides or erucate amides, or aliphatic esters such as stearyl tearates or hydrogenated beef tallow.

Methods of incorporating lubricants into styrene group resins include methods of adding lubricants during compounding reactions, methods of thermoforming pellets for adding together with additives such as stabilizers after compounding, etc., and even adding lubricants to the final product or adding lubricants to additive materials in cases where particularly high viscosity is required during thermoforming, etc.

(Problem resolved by the invention)

If resin flow characteristics are poor during injection molding of formed products having complex shapes or large formed products, time may be required for resin solution injected into a mold to fill the mold, resulting in poor productivity, or partial hardening may occur before the injected resin fills the mold so that it is not possible to obtain a formed product in the designed shape, and also flashing or flow marking may occur causing surface flaws or loss of surface finish in the formed product.

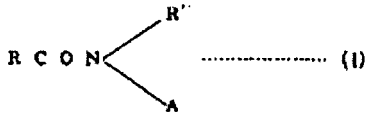
Increasing thermoforming temperature in order to enhance the flow characteristics of resin causes problems such as coloring of resin or increased energy cost. Also, addition of more lubricants can cause problems such as increased smoking during thermoforming, harming the working environment, or reduction of the thermoforming temperature of the product.

The present invention has the objective of providing a styrene group resin compound that enhances flow characteristics without the addition lubricant content percentages used in the past.

(Means of resolving the problem)

The present invention has been completed with the discovery of greatly enhanced resin flow characteristics, by including specific N- replacement aliphatic amides as lubricants in a styrene group resin.

The N-replacement aliphatic amide used in the present invention is indicated by the following general formula (1).



..... (1)

(R is an alkyl group or alkenyl group of 7 to 21 carbons, R' is an alkyl group or alkenyl group of 8-22 carbons, A is an alkyl group or alkenyl group of 8-22 carbons or a hydrogen atom, and one or both of R and R' is an alkenyl group.)

If both R and R' are alkyl groups, the flow charactieristics of the resin are little different than prior resins. In the present invention at least one alkenyl group is required among the N-replacement aliphatic amide molecules.

The N-replacement aliphatic amides used in the present invention specifically include N-capryl erucate amide, N-lauryl erucate amide, N-lauryl oleate amide, N-stearyl erucate mide, N,N-distearyl erucate amide, N-stearyl oleate amide N,N-distearyl oleate amide, N-behenyl erucate amide, N-gehenyl oleate amide, N-loeyl oleate amide, N-oleyl erucate amide, N,N-dioleyl oleate amide, N,N-dioleyl erucate amide, N-oleyl stearate amide, N,N-dioleyl stearate amide, N-erucyl oleate amide, N-erucyl erucate amide, N-erucyl caprate amide, N-erucyl laurate amide, N-erucyl stearate amide, N-erucyl behnate amide, etc.

The N-replacement aliphatic amides used in the present invention are easily obtained from a fatty acid of 8 to 22 carbons and a primary or secondary aliphatic amine of 8 to 22 carbons by a dehydration reaction at 150-300°C, however naturally other methods of manufacture may also be used. At this point it is necessary that at least one of the fatty acid or aliphatic amine be an unsaturated compound.

A styrene group resins according to the present invention is a compound resin having as necessary constituent units a styrene monomer or alpha-methyl styrene monomer such as polystyrene, ABS resin, AS resin, styrene anhydrous maleate copolymer etc.

In the present invention, the content of N-replacement aliphatic amide in general formula (1) is 0.01-5, and preferably 0.05-3, per 100 styrene group resin by weight. Below 0.01 by weight there is virtually no enhancement of resin flow characteristics, and above 5 by weight the thermoforming temperature of the resin is reduced.

By means of the present invention, because the mutual solubility of an N-replacement aliphatic amide of general formula (1) with styrene group resins is assured, it is believed that during thermoforming of styrene group resins, the molecules of N-replacement aliphatic amide exist well among polymer molecules, and between polymer molecules and the mold wall, and therefore exhibit excellent flow characteristics.

(Effect of the present invention)

A styrene group resin compound by means of the present invention has excellent flow characteristics in thermoforming and thereby is able to enhance productivity, and also is able to obtain attractive surface finish in complex molded products. In addition it has excellent release characteristics and thereby is also able to enhance productivity.

(Preferred embodiments)

Preferred embodiment 1

After adding lubricant of one part by weight per 100 parts by weight of ABS resin (additive ABS-HH, manufactured by Denki Kagaku Kogyou Kabushiki Kaisha (Denka)) and compounding, the result was extruded and pelletized at 220°C. A spiral flow test was performed using these pellets in an injection molding machine. The test conditions were injection pressure 60 kg/ml, cylinder temperature 245°C, mold temperature 40°C. The spiral cross section was semicircular with a diameter of 6mm, and the maximum flow length of the spiral was 208cm.

Table 1 shows the types of lubricant and data from the flow test. The better the flow characteristics of the resin solution, the better the molded product.

It can be seen that the styrene group resin compounds according to the present invention have better flow characteristics in comparison to prior comparison products.

Table 1

	No.	Lubricant			Spiral flow length (cm)
		RCO 1)	R' 2)	A 2)	
Products according to the present invention	1	$C_{22}F_1$	C_{12}	H	77
	2	$C_{18}F_1$	C_{12}	H	77
	3	$C_{22}F_1$	C_{18}	H	78
	4	$C_{22}F_1$	C_{18}	C_{18}	84
	5	$C_{22}F_1$	C_{22}	H	81
	6	$C_{18}F_1$	$C_{18}F_1$	H	86
	7	$C_{22}F_1$	$C_{18}F_1$	H	86
	8	$C_{18}F_1$	$C_{18}F_1$	$C_{18}F_1$	76
	9	C_{18}	$C_{18}F_1$	$C_{18}F_1$	77
Comparison products	10	C_{18}	C_{18}	H	56
	11	C_{18}	C_{18}	C_{18}	53
	12	C_{22}	C_{18}	H	53
	13	C_{22}	C_{22}	H	62
	14	N,N'-bis-stearoethylene diamine			64
	15	Stearate amide			53
	16	Erucate amide			65
	17	Stearate stearyl			58
	18	None			50

Notes: 1) $C_{18}F_1$ Oleoyl group, C_{22} F1 Erucoyl group, C_{18} Stearoyl group, C_{22} Behenoyl group
2) $C_{18}F_1$ Oleoyl group, C_{12} Lauroyl group, C_{18} Stearoyl group, C_{22} Behenoyl group

Preferred embodiment 2

After adding lubricant of 0.7 parts by weight per 100 parts by weight of polystyrene resin (Diarex HF-77, manufactured by Mitsubishi Monsanto Chemical Co.) and

compounding, the result was extruded and pelletized at 220°C. A spiral flow test was performed using these pellets in an injection molding machine. The test conditions were the same as for the first preferred embodiment.

Table 2 shows the types of lubricant and data from the flow test.

It can be seen that the styrene group resin compounds according to the present invention have better flow characteristics in comparison to prior comparison products.

Table 2

	No.	Lubricant			Spiral flow length (cm)
		RCO 1)	R' 2)	A 2)	
Products according to the present invention	19	$C_{22}F_1$	C_{12}	H	122
	20	$C_{22}F_1$	C_{18}	H	135
	21	$C_{22}F_1$	C_{18}	C_{18}	137
	22	$C_{18}F_1$	$C_{18}F_1$	H	129
	23	$C_{18}F_1$	C_{18}	C_{18}	131
Comparison products	24	C_{18}	C_{18}	H	103
	25	C_{22}	C_{22}	H	106
	26	N,N'-bis-stearoethylene diamine			110
	27	Erucate amide			98
	28	None			91

Note: 1) 2) Same as Table 1.